MEMORANDUM

TO: Joanna L. French, P.E. JLF

FROM: Eric S. Rowland ESR

SUBJECT: **Croda, Inc.**
Atlas Point
Draft/Proposed Permit: APC-2016/0068-CONSTRUCTION (Amendment 4) (NSPS) (MACT) (VOC RACT) (MNSR) (FE)

DATE: May 24, 2021

BACKGROUND INFORMATION

Croda, Inc. (Croda or the Company) operates a multi-step continuous process to produce ethylene oxide from ethanol. Ethanol is reacted with oxygen to form ethylene, which is in turn reacted to form ethylene oxide. The ethylene oxide (EO) is purified, stored, and used on-site as a raw material in manufacturing certain products. The design capacity of the plant is 30,000 TPY of EO. Major emitting equipment include an ethanol dehydration furnace (EDF, 12.47 MMBTU/hr), a catalytic oxidizer (CCU, <1 MMBTU/hr) to control emissions from the carbonate regenerator and two EO storage tanks. Side-streams include technical grade mono-ethylene glycol, polyglycols, and by-product carbon dioxide. Certain gas streams generated by the process, which contain organic constituents, are controlled by destruction in the EDF or catalytic oxidizer. Other sources of emissions include an ethyl chloride chemical addition pot, start-up/shutdown activities, storage tanks, an emergency generator, three fire pumps, and fugitive sources.

On September 17, 2020, Croda performed performance testing (stack testing) of the T-330 Vent Scrubber and F-610 Drying Column Hotwell components of the Ethylene Oxide (EO) Plant as prescribed in Permit: AQM-003/00058 (Renewal 3) (Revision 5). Testing was stopped midway through the planned tests due to concerns about results observed in the hotwell, and the EO Plant was placed into a maintenance shut down. Due to this plant shutdown, additional testing of the B-1210 Ethanol Dehydration Furnace and the U-240 Catalytic Combustion Unit was not performed. The partial test results obtained showed violations of the emissions limits for the T-330 Vent Scrubber and F-610 Drying Column Hotwell.

An amendment letter for **Permit: APC-2016/0068-CONSTRUCTION (Amendment 4) (NSPS) (MACT) (VOC RACT) (MNSR) (FE)**, dated December 30, 2020, was received on January 4, 2021. This letter requests that the following changes be made:

- For the T-330 Vent Scrubber, two operating scenarios be allowed. The first scenario would be for normal operation where vent gases would pass through the scrubber and then be directed back into the process. The second scenario would be for maintenance activities (while the EO Plant was off-line) such as purging of transfer lines and storage tanks. In this second scenario, vent gases would pass through the scrubber and exhaust to atmosphere.
- For the F-610 Drying Column Hotwell, the vapors/gases from this unit will be re-routed to B-1210 Ethanol Dehydration Furnace for destruction. No emissions to atmosphere would occur.
- For the B-1210 Ethanol Dehydration Furnace, increases were requested for the emissions limits for CO, NO_X, SO_2, VOC, and PM_{10}. These increases are requested not due to a change, but due to an error in the original permit where average values were used instead of design (or worst case) values.

On January 12, 2021, re-testing of the T-330 Vent Scrubber was performed (at a higher water flow rate than the September 2020 testing). This testing achieved passing results. The changes proposed in the permit application have been discussed with Croda, and they state that vent gases will be flowed through

(not diverted around) the vent scrubber. As such, the Division feels it is necessary to maintain water flow through the scrubber at all times. Croda's Operations group has questioned the need for this continuous water flow when the vent gases are being directed back into the process, however the Safety, Health, and Environmental (SHE) group has acknowledged the necessity for this provision.

On February 26, 2021, a Settlement Agreement was reached between the Department and Croda regarding exceedances during the September 17, 2020 and January 13-14, 2021 performance tests (B-1210 Ethanol Dehydration Furnace and U-240 Catalytic Combustion Unit). This Settlement Agreement calls for certain changes to the Title V permit, which are first being made to this underlying Regulation 1102 construction permit.

The text of Condition 3.17 refers to the venting of the Ethylene Purification Tower, and is no longer accurate. This condition was not incorporated into Permit: AQM-003/00058 (Renewal 3) (Revision 5), as documented in the November 18, 2019 memo (which references a letter from March 5, 2018). It is being removed from this underlying Regulation 1102 permit at this time.

The changes to be made in this Amendment are shown in Table 1 below:

Table 1: Amendment 4 Changes to APC-2016/0068-CONSTRUCTION

Condition	Existing Wording	New Wording
Changes related to the F-610 Drying Column Hotwell made in accordance with Paragraph 14 of the Settlement Agreement and the Permit Application:		
3.24	The owner or operator shall maintain a TRE index value greater than 1.0 without use of VOC emission control devices for the hotwell.	Reserved.
4.14	For the purposes of demonstrating that the hotwell formaldehyde concentration is less than 500 ppmv:.	Reserved.
4.14.1	The process vent stream composition shall be determined by calculations based on material balances, process stoichiometry, or previous test results, provided that the results are still relevant to the current process vent stream conditions.	(deleted)
4.14.2	The owner or operator shall demonstrate that the concentration of TOC (including methane and ethane) measured by Method 25A is less than 250 ppmv with a VOC concentration of less than 500 ppmv to qualify for the low-concentration exclusion of 7 **DE Admin. Code** 1124 Section 48.1.2.4.	(deleted)
4.15	40 CFR 60 Subpart NNN §60.664(e) and (f) shall be used to determine the hotwell process vent stream TRE index value to show compliance with Condition 3.24.	Reserved.

Table 1: Amendment 4 Changes to APC-2016/0068-CONSTRUCTION

Condition	Existing Wording	New Wording
4.16	To comply with Condition 3.24, the owner or operator shall recalculate the TRE index value for the hotwell whenever process changes are made. Examples of process changes include changes in production capacity, feedstock type, or catalyst type, or whenever there is replacement, removal, or addition of recovery equipment. The TRE index value shall be recalculated based on test data, or on best engineering estimates of the effects of the change to the recovery system.	Reserved.
4.5	Compliance with Conditions 2.1.1 (CO), 2.1.2 (NO_X), 2.1.4.1 (VOC), 2.1.4.2 (TOC), 2.1.5 (PM_{10}), 2.2.1 (CO), 2.2.2 (NO_X), 2.2.4 (VOC), and 2.2.5 (PM_{10}) shall be demonstrated by an initial stack test then subsequently once every 5 years thereafter. An initial performance test on the hotwell vent in accordance with 7 DE Admin. Code 1124, Section 48.4.9 shall be performed to demonstrate VOC emissions are less than 500 ppmv. Subsequent testing shall be conducted if a process change as described in Condition 4.6 is made. Testing shall be conducted while the unit is operated under the condition/conditions defined in a Department approved test protocol.	Compliance with Conditions 2.1.1 (CO), 2.1.2 (NO_X), 2.1.4.1 (VOC), 2.1.4.2 (TOC), 2.1.5 (PM_{10}), 2.2.1 (CO), 2.2.2 (NO_X), 2.2.4 (VOC), and 2.2.5 (PM_{10}) shall be demonstrated by an initial stack test then subsequently once every 5 years thereafter. Subsequent testing shall be conducted if a process change as described in Condition 4.6 is made. Testing shall be conducted while the unit is operated under the condition/conditions defined in a Department approved test protocol.
5.3.16	Records of the VOC concentration to be less than 500 ppmv at the hotwell. Records consist of an initial test unless a feedstock change requires additional testing.	Reserved.
5.3.17	Compliance with the hotwell maintaining a TRE index value greater than 1.0 without the use of VOC emission control devices shall keep the following records:	Reserved.
5.3.17.1	Any changes in production capacity, feedstock type, or catalyst type, or of any replacement, removal or addition	(deleted)

Table 1: Amendment 4 Changes to APC-2016/0068-CONSTRUCTION

Condition	Existing Wording	New Wording
	of recovery equipment or a distillation unit;	
5.3.17.2	Any recalculation of the TRE index value performed pursuant to Condition 4.16; and	(deleted)
5.3.17.3	The results of any performance test performed pursuant to the methods and procedures required by §60.664(e).	(deleted)
Changes related to the T-330 Vent Scrubber made in accordance with Paragraph 16 of the Settlement Agreement:		
3.4	The 30,000 gallon ethylene oxide tanks' scrubber shall be designed and operated to reduce inlet VOC emissions by 95 percent or greater.	The 30,000 gallon ethylene oxide tanks' scrubber shall be designed and operated to reduce inlet VOC emissions by 99 percent or greater.
Changes related to the T-330 Vent Scrubber made in accordance with Paragraph 20 of the Settlement Agreement:		
2.3.1	Volatile Organic Compound (VOC) Emissions VOC emissions shall not exceed 0.58 tons per twelve (12) month rolling period.	Volatile Organic Compound (VOC) Emissions VOC emissions shall not exceed 0.024 tons/month and 0.29 tons per twelve (12) month rolling period.
Changes related to the T-330 Vent Scrubber made in accordance with Paragraph 24 of the Settlement Agreement:		
3.5.1	(new)	The closed vent system and scrubber parameters shall be set based on the last passing performance test. Parameters shall include, but are not limited to, scrubber water flow rate and vent gas flow rate.
3.5.2	(new)	The scrubber shall be in operation whenever any vent gas is present.
Changes related to the B-1210 Ethanol Dehydration Furnace made in accordance with Paragraph 28 of the Settlement Agreement and Permit Application:		
2.1.1	Carbon Monoxide (CO) Emissions CO emissions shall not exceed 0.46 pounds per hour and 2.0 tons per twelve (12) month rolling period.	Carbon Monoxide (CO) Emissions CO emissions shall not exceed 1.0 pounds per hour and 4.5 tons per twelve (12) month rolling period.
2.1.2	Nitrogen Oxides (NOx) Emissions NOx emissions shall not exceed 0.33 pounds per hour and 1.4 tons per twelve (12) month rolling period.	Nitrogen Oxides (NOx) Emissions NOx emissions shall not exceed 0.74 pounds per hour and 3.2 tons per twelve (12) month rolling period.
2.1.3	Sulfur Dioxide (SO2) Emissions SO2 emissions shall not exceed 0.014 tons per twelve (12) month rolling period.	Sulfur Dioxide (SO2) Emissions SO2 emissions shall not exceed 0.0073 pounds per hour and 0.29 tons per twelve (12) month rolling period.

Table 1: Amendment 4 Changes to APC-2016/0068-CONSTRUCTION

Condition	Existing Wording	New Wording
2.1.4.1	VOC emissions shall not exceed 1.0 pounds per hour and 4.5 tons per twelve (12) month rolling period.	VOC emissions shall not exceed 1.3 pounds per hour and 5.7 tons per twelve (12) month rolling period.
2.1.5	Particulate Matter (PM10) Emissions PM10 emissions shall not exceed 0.04 pounds per hour and 0.18 tons per twelve (12) month rolling period.	Particulate Matter (PM10) Emissions PM10 emissions shall not exceed 0.093 pounds per hour and 0.41 tons per twelve (12) month rolling period.
Changes related to the ethylene purification column made in accordance with the letter from March 5, 2018:		
3.17	The ethylene purification column shall vent to Boiler 5 during start-ups and extended shutdowns.	Reserved.

Technical Discussion

During the permit application process for the EO Plant, some supplementary information provided both "normal" emissions values and "design" emissions values. The construction permit, through amendment 3, has been based on the "normal" emissions values. These values do not take into account the conditions experienced at the end of the EO catalyst life. This error has been identified, and in order to correct it in this Amendment 4, an evaluation of AERSCREEN modeling is necessary for the increased limits.

AERSCREEN Modeling

The effects of air contaminant emissions from the operation of the B-1210 Ethanol Dehydration Furnace (EDF) on the public health, safety, and welfare were assessed using Department criteria. The criteria assume no adverse effect when the ratio of the Threshold Limit Value to the Maximum Downwind Concentration (TLV:MDC) is at least 100:1 at the nearest property line and beyond for each air contaminant released. The TLV of each air contaminant was obtained from the 2020 TLVs® and BEIs®, published by the American Conference of Governmental Industrial Hygienists (ACGIH). The MDC of each air contaminant was computed using AERSCREEN air dispersion modeling. AERSCREEN is EPA's recommended screening-level air quality model based on AERMOD.

AERSCREEN is an interactive command-prompt application that interfaces with MAKEMET for generating the meteorological matrix, but also interfaces with AERMAP and BPIPPRM to automate the processing of terrain and building information, and interfaces with AERMOD model utilizing the SCREEN option to perform the modeling runs. The AERSCREEN program also includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr and annual averages.

In utilizing AERSCREEN, the EDF was treated as a point source. Point source variables in AERSCREEN are air contaminant emission rates (in lb/hr), stack height (in ft), stack inside diameter (in inches), stack gas exit velocity (in ft/s) or air flow rate (in acfm), plume exit temperature (in °F), and the urban/rural land use options. The variables used are shown in the Table 2 below.

Table 2: AERSCREEN Point Source Variables for the Ethanol Dehydration Furnace

Parameter	EDF
Emission Rate (lb/hr)[1]	1
Stack Height (ft)	85
Stack Inner Diameter (in)	47.04
Plume Exit Temperature (°F)	750
Stack Air Flow Rate (ACFM)	10207
Land Use	Rural
Minimum Distance to Ambient (ft)	140
$MDC_{8\text{-}hr}$ ($\mu g/m^3$):	2.312

[1] – AERSCREEN was run at an emission rate of 1 lb/hr, and this result used to compute a value for each contaminant

Using the $MDC_{8\text{-}hr}$ value computed for 1 lb/hr, the $MDC_{8\text{-}hr}$ for each pollutant and then the TLV:MDC ratio were computed and are shown in Table 3.

Table 3: Ethanol Dehydration Furnace TLV:MDC Evaluation

Pollutant	TLV_{TWA} (mg/m^3)	Emission Rate (lb/hr)	$MDC_{8\text{-}hr}$ ($\mu g/m^3$)[1]	TLV:MDC
CO	28.64	1.0	2.31	12,387
NO_X (as NO_2)	0.38	0.74	1.71	222
SO_2	0.66[2]	0.0073	0.017	39,105
VOC (as benzene)	1.6	1.3	3.01	532
PM_{10}	10	0.093	0.22	46,508

[1] – Sample Calculation: ($MDC_{8\text{-}hr}$ @ 1 lb/hr) * (Emission Rate)
[2] – The TLV value available for SO_2 is a Short Term Exposure Limit (STEL)

AERSCREEN predicts that the MDC for these pollutants will occur 128 feet from the stack of the EDC, with the distance to the nearest property line being 140 feet. The TLV:MDC ratios at this distance are greater than 100:1 criteria established by the Department. As such, public health, safety and welfare are presumed to not be adversely impacted by these emissions.

RECOMMENDATIONS

I recommend that the attached Draft/Proposed Permit be advertised on May 30, 2021, with notice of a Public Hearing (as per the Office of the Secretary's request) on June 29, 2021, the attached letter and Draft/Proposed Permit be sent to the facility, this technical memorandum and the Draft/Proposed Permit be emailed to the EPA, and Section A and Section B be emailed to the affected states.

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pc: Dover Title V File
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